

## Quad 2-Input Register

### Features

- Function, pinout and drive compatible with FCT and F logic
- FCT-C speed at 6.1 ns max. (Com'l)  
FCT-A speed at 7.0 ns max. (Com'l)
- Reduced  $V_{OH}$  (typically = 3.3V) versions of equivalent FCT functions
- Edge-rate control circuitry for significantly improved noise characteristics
- Power-off disable feature
- Matched rise and fall times

- ESD > 2000V
- Fully compatible with TTL input and output logic levels
- Sink current      **64 mA (Com'l),  
32 mA (Mil)**  
Source current    **32 mA (Com'l),  
12 mA (Mil)**

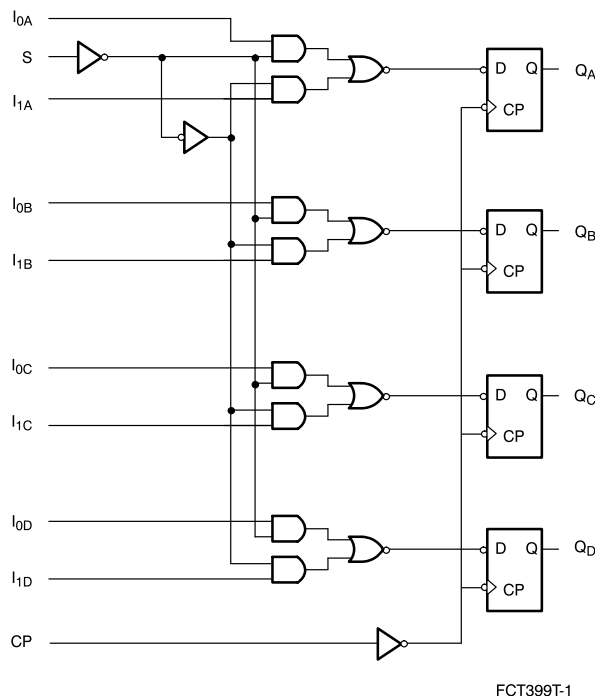
### Functional Description

The FCT399T is a high-speed quad dual-port register that selects four bits of data from either of two sources (Ports) under control of a common Select input (S). The

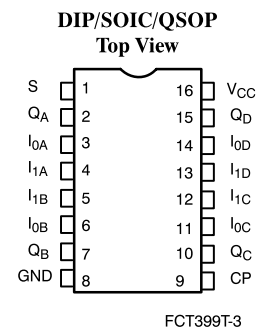
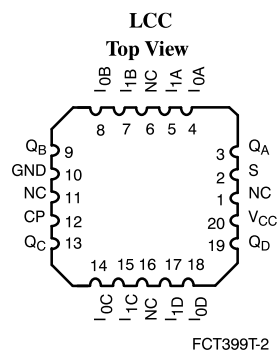
selected data is transferred to a 4-bit output register synchronous with the LOW-to-HIGH transition of the Clock input (CP). The 4-bit D-type output register is fully edge-triggered. The Data inputs ( $I_{0X}$ ,  $I_{1X}$ ) and Select input (S) must be stable only one set-up time prior to, and hold time after, the LOW-to-HIGH transition of the Clock input for predictable operation. The FCT399T offers true outputs.

The outputs are designed with a power-off disable feature to allow for live insertion of boards.

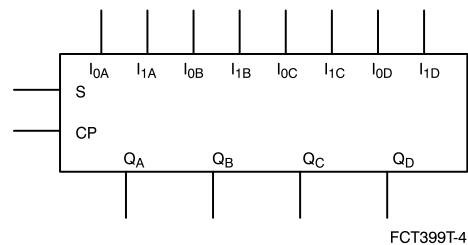
### Logic Block Diagram



### Pin Configurations



### Logic Symbol



### Pin Description

| Name  | Description                            |
|-------|--|
| S     | Common Select Input                    |
| CP    | Clock Pulse Input (Active Rising Edge) |
| $I_0$ | Data Inputs from Source 0              |
| $I_1$ | Data Inputs from Source 1              |
| Q     | Register True Outputs                  |

### Function Table<sup>[1]</sup>

| Inputs |       |       | Outputs |
|--------|-------|-------|---------|
| S      | $I_0$ | $I_1$ | Q       |
| l      | l     | X     | L       |
| l      | h     | X     | H       |
| h      | X     | l     | L       |
| h      | X     | h     | H       |

#### Note:

1. H = HIGH Voltage Level  
h = HIGH Voltage Level one set-up time prior to the LOW-to-HIGH Clock Transition  
L = LOW Voltage Level  
l = LOW Voltage Level one set-up time prior to the LOW-to-HIGH Clock Transition  
X = Don't Care

**Maximum Ratings**<sup>[2, 3]</sup>

(Above which the useful life may be impaired. For user guidelines, not tested.)

Storage Temperature .....  $-65^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$   
 Ambient Temperature with  
 Power Applied .....  $-65^{\circ}\text{C}$  to  $+135^{\circ}\text{C}$   
 Supply Voltage to Ground Potential .....  $-0.5\text{V}$  to  $+7.0\text{V}$   
 DC Input Voltage .....  $-0.5\text{V}$  to  $+7.0\text{V}$   
 DC Output Voltage .....  $-0.5\text{V}$  to  $+7.0\text{V}$   
 DC Output Current (Maximum Sink Current/Pin) .... 120 mA  
 Power Dissipation ..... 0.5W

Static Discharge Voltage .....  $>2001\text{V}$   
 (per MIL-STD-883, Method 3015)

**Operating Range**

| Range                   | Range | Ambient Temperature                             | V <sub>CC</sub>      |
|-------------------------|-------|---|----------------------|
| Commercial              | CT    | $0^{\circ}\text{C}$ to $+70^{\circ}\text{C}$    | $5\text{V} \pm 5\%$  |
| Commercial              | T, AT | $-40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$  | $5\text{V} \pm 5\%$  |
| Military <sup>[4]</sup> | All   | $-55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | $5\text{V} \pm 10\%$ |

**Electrical Characteristics** Over the Operating Range

| Parameter        | Description                                 | Test Conditions   |       | Min. | Typ. <sup>[5]</sup> | Max. | Unit |
|------------------|---|---|-------|------|---------------------|------|------|
| V <sub>OH</sub>  | Output HIGH Voltage                         | V <sub>CC</sub> =Min., I <sub>OH</sub> =-32 mA          | Com'l | 2.0  |                     |      | V    |
|                  |   | V <sub>CC</sub> =Min., I <sub>OH</sub> =-15 mA          | Com'l | 2.4  | 3.3                 |      | V    |
|                  |   | V <sub>CC</sub> =Min., I <sub>OH</sub> =-12 mA          | Mil   | 2.4  | 3.3                 |      | V    |
| V <sub>OL</sub>  | Output LOW Voltage                          | V <sub>CC</sub> =Min., I <sub>OL</sub> =64 mA           | Com'l |      | 0.3                 | 0.55 | V    |
|                  |   | V <sub>CC</sub> =Min., I <sub>OL</sub> =32 mA           | Mil   |      | 0.3                 | 0.55 | V    |
| V <sub>IH</sub>  | Input HIGH Voltage                          |   |       | 2.0  |                     |      | V    |
| V <sub>IL</sub>  | Input LOW Voltage                           |   |       |      |                     | 0.8  | V    |
| V <sub>H</sub>   | Hysteresis <sup>[6]</sup>                   | All inputs  |       |      | 0.2                 |      | V    |
| V <sub>IK</sub>  | Input Clamp Diode Voltage                   | V <sub>CC</sub> =Min., I <sub>IN</sub> =-18 mA          |       |      | -0.7                | -1.2 | V    |
| I <sub>I</sub>   | Input HIGH Current                          | V <sub>CC</sub> =Max., V <sub>IN</sub> =V <sub>CC</sub> |       |      |                     | 5    | μA   |
| I <sub>IH</sub>  | Input HIGH Current                          | V <sub>CC</sub> =Max., V <sub>IN</sub> =2.7V            |       |      |                     | ±1   | μA   |
| I <sub>IL</sub>  | Input LOW Current                           | V <sub>CC</sub> =Max., V <sub>IN</sub> =0.5V            |       |      |                     | ±1   | μA   |
| I <sub>OS</sub>  | Output Short Circuit Current <sup>[7]</sup> | V <sub>CC</sub> =Max., V <sub>OUT</sub> =0.0V           |       | -60  | -120                | -225 | mA   |
| I <sub>OFF</sub> | Power-Off Disable                           | V <sub>CC</sub> =0V, V <sub>OUT</sub> =4.5V             |       |      |                     | ±1   | μA   |

**Capacitance**<sup>[6]</sup>

| Parameter        | Description        | Typ. <sup>[5]</sup> | Max. | Unit |
|------------------|--------------------|---------------------|------|------|
| C <sub>IN</sub>  | Input Capacitance  | 5                   | 10   | pF   |
| C <sub>OUT</sub> | Output Capacitance | 9                   | 12   | pF   |

**Notes:**

- Unless otherwise noted, these limits are over the operating free-air temperature range.
- Unused inputs must always be connected to an appropriate logic voltage level, preferably either V<sub>CC</sub> or ground.
- T<sub>A</sub> is the "instant on" case temperature.
- Typical values are at V<sub>CC</sub>=5.0V, T<sub>A</sub>=+25°C ambient.
- This parameter is guaranteed but not tested.
- Not more than one output should be shorted at a time. Duration of short should not exceed one second. The use of high-speed test apparatus and/or sample and hold techniques is preferable in order to minimize internal chip heating and more accurately reflect operational values. Otherwise prolonged shorting of a high output may raise the chip temperature well above normal and thereby cause invalid readings in other parametric tests. In any sequence of parameter tests, I<sub>OS</sub> tests should be performed last.

**Power Supply Characteristics**

| Parameter       | Description                                 | Test Conditions  | Typ. <sup>[5]</sup> | Max.                | Unit       |
|-----------------|---|--|---------------------|---------------------|------------|
| $I_{CC}$        | Quiescent Power Supply Current              | $V_{CC} = \text{Max.}, V_{IN} \leq 0.2V$ ,<br>$V_{IN} \geq V_{CC} - 0.2V$  | 0.1                 | 0.2                 | mA         |
| $\Delta I_{CC}$ | Quiescent Power Supply Current (TTL inputs) | $V_{CC} = \text{Max.}, V_{IN} = 3.4V$ , <sup>[8]</sup><br>$f_1 = 0$ , Outputs Open   | 0.5                 | 2.0                 | mA         |
| $I_{CCD}$       | Dynamic Power Supply Current <sup>[9]</sup> | $V_{CC} = \text{Max.}$ , One Input Toggling,<br>50% Duty Cycle, Outputs Open,<br>$V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$   | 0.06                | 0.12                | mA/<br>MHz |
| $I_C$           | Total Power Supply Current <sup>[10]</sup>  | $V_{CC} = \text{Max.}$ , $f_0 = 10$ MHz,<br>50% Duty Cycle, Outputs Open,<br>One Input Toggling at $f_1 = 5$ MHz,<br>S=Steady State<br>$V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$   | 0.7                 | 1.4                 | mA         |
|                 |   | $V_{CC} = \text{Max.}$ , $f_0 = 10$ MHz,<br>50% Duty Cycle, Outputs Open,<br>One Input Toggling at $f_1 = 5$ MHz,<br>S=Steady State<br>$V_{IN} = 3.4V$ or $V_{IN} = \text{GND}$            | 1.2                 | 3.4                 | mA         |
|                 |   | $V_{CC} = \text{Max.}$ , $f_0 = 10$ MHz,<br>50% Duty Cycle, Outputs Open,<br>Four Inputs Toggling at $f_1 = 5$ MHz,<br>S=Steady State<br>$V_{IN} \leq 0.2V$ or $V_{IN} \geq V_{CC} - 0.2V$ | 1.6                 | 3.2 <sup>[11]</sup> | mA         |
|                 |   | $V_{CC} = \text{Max.}$ , $f_0 = 10$ MHz,<br>50% Duty Cycle, Outputs Open,<br>Four Inputs Toggling at $f_1 = 5$ MHz,<br>S=Steady State<br>$V_{IN} = 3.4V$ or $V_{IN} = \text{GND}$          | 2.9                 | 8.2 <sup>[11]</sup> | mA         |

**Notes:**

8. Per TTL driven input ( $V_{IN} = 3.4V$ ); all other inputs at  $V_{CC}$  or GND.

9. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

10.  $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_0/2 + f_1 N_1)$   
 $I_{CC}$  = Quiescent Current with CMOS input levels  
 $\Delta I_{CC}$  = Power Supply Current for a TTL HIGH input ( $V_{IN} = 3.4V$ )  
 $D_H$  = Duty Cycle for TTL inputs HIGH

$N_T$  = Number of TTL inputs at  $D_H$

$I_{CCD}$  = Dynamic Current caused by an input transition pair (HLH or LHL)

$f_0$  = Clock frequency for registered devices, otherwise zero

$f_1$  = Input signal frequency

$N_1$  = Number of inputs changing at  $f_1$

All currents are in milliamps and all frequencies are in megahertz.

11. Values for these conditions are examples of the  $I_{CC}$  formula. These limits are guaranteed but not tested.

**Switching Characteristics** Over the Operating Range

| Parameter                            | Description  | FCT399T              |      |                      |      | FCT399AT             |      |                      |      | Unit | Fig. No. <sup>[13]</sup> |
|--------------------------------------|--|----------------------|------|----------------------|------|----------------------|------|----------------------|------|------|--------------------------|
|                                      |  | Military             |      | Commercial           |      | Military             |      | Commercial           |      |      |                          |
|                                      |  | Min. <sup>[12]</sup> | Max. | Min. <sup>[12]</sup> | Max. | Min. <sup>[12]</sup> | Max. | Min. <sup>[12]</sup> | Max. |      |                          |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay<br>CP to Q                       | 3.0                  | 11.5 | 3.0                  | 10.0 | 2.5                  | 7.5  | 2.5                  | 7.0  | ns   | 1, 5                     |
| t <sub>S</sub>                       | Set-Up Time<br>HIGH or LOW<br>I <sub>n</sub> to CP | 4.5                  |      | 3.5                  |      | 4.0                  |      | 3.5                  |      | ns   | 4                        |
| t <sub>H</sub>                       | Hold Time<br>HIGH or LOW<br>I <sub>n</sub> to CP   | 1.5                  |      | 1.0                  |      | 1.0                  |      | 1.0                  |      | ns   | 4                        |
| t <sub>S</sub>                       | Set-Up Time<br>HIGH or LOW<br>S to CP              | 9.5                  |      | 8.5                  |      | 9.0                  |      | 8.5                  |      | ns   | 4                        |
| t <sub>H</sub>                       | Hold Time<br>HIGH or LOW<br>S to CP                | 0                    |      | 0                    |      | 0                    |      | 0                    |      | ns   | 4                        |
| t <sub>w</sub>                       | Clock Pulse Width <sup>[6]</sup><br>HIGH or LOW    | 7.0                  |      | 5.0                  |      | 6.0                  |      | 5.0                  |      | ns   | 5                        |

| Parameter                            | Description                                    | FCT399CT             |      |                      |      | Unit | Fig. No. <sup>[13]</sup> |
|--------------------------------------|--|----------------------|------|----------------------|------|------|--------------------------|
|                                      |  | Military             |      | Commercial           |      |      |                          |
|                                      |  | Min. <sup>[12]</sup> | Max. | Min. <sup>[12]</sup> | Max. |      |                          |
| t <sub>PLH</sub><br>t <sub>PHL</sub> | Propagation Delay CP to Q                      | 2.5                  | 6.6  | 2.5                  | 6.1  | ns   | 1, 5                     |
| t <sub>S</sub>                       | Set-Up Time, HIGH or LOW, I <sub>n</sub> to CP | 4.0                  |      | 3.5                  |      | ns   | 4                        |
| t <sub>H</sub>                       | Hold Time, HIGH or LOW, I <sub>n</sub> to CP   | 1.0                  |      | 1.0                  |      | ns   | 4                        |
| t <sub>S</sub>                       | Set-Up Time, HIGH or LOW, S to CP              | 9.0                  |      | 8.5                  |      | ns   | 4                        |
| t <sub>H</sub>                       | Hold Time, HIGH or LOW, S to CP                | 0                    |      | 0                    |      | ns   | 4                        |
| t <sub>W</sub>                       | Clock Pulse Width <sup>[6]</sup> HIGH or LOW   | 6.0                  |      | 5.0                  |      | ns   | 5                        |

**Notes:**

12. Minimum limits are guaranteed but not tested on Propagation Delays. 13. See "Parameter Measurement Information" in the General Information Section.



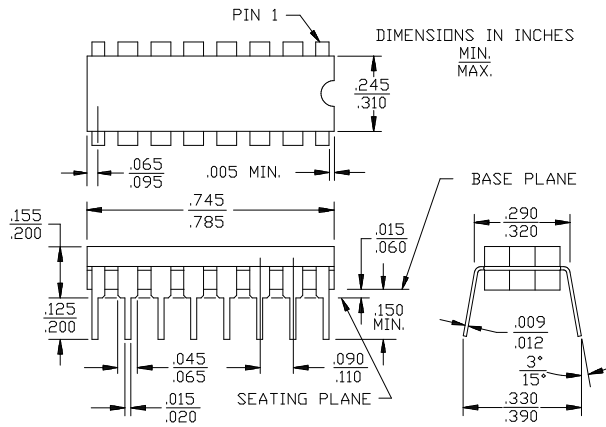
**Ordering Information**

| Speed (ns) | Ordering Code   | Package Name | Package Type                        | Operating Range |
|------------|-----------------|--------------|-------------------------------------|-----------------|
| 6.1        | CY74FCT399CTPC  | P1           | 16-Lead (300-Mil) Molded DIP        | Commercial      |
|            | CY74FCT399CTQC  | Q1           | 16-Lead (150-Mil) QSOP              |                 |
|            | CY74FCT399CTSOC | S1           | 16-Lead (300-Mil) Molded SOIC       |                 |
| 6.6        | CY54FCT399CTDMB | D2           | 16-Lead (300-Mil) CerDIP            | Military        |
|            | CY54FCT399CTLMB | L61          | 20-Pin Square Leadless Chip Carrier |                 |
| 7.0        | CY74FCT399ATPC  | P1           | 16-Lead (300-Mil) Molded DIP        | Commercial      |
|            | CY74FCT399ATQC  | Q1           | 16-Lead (150-Mil) QSOP              |                 |
|            | CY74FCT399ATSOC | S1           | 16-Lead (300-Mil) Molded SOIC       |                 |
| 7.5        | CY54FCT399ATDMB | D2           | 16-Lead (300-Mil) CerDIP            | Military        |
|            | CY54FCT399ATLMB | L61          | 20-Pin Square Leadless Chip Carrier |                 |
| 10.0       | CY74FCT399TPC   | P1           | 16-Lead (300-Mil) Molded DIP        | Commercial      |
|            | CY74FCT399TQC   | Q1           | 16-Lead (150-Mil) QSOP              |                 |
|            | CY74FCT399TSOC  | S1           | 16-Lead (300-Mil) Molded SOIC       |                 |
| 11.5       | CY54FCT399TDMB  | D2           | 16-Lead (300-Mil) CerDIP            | Military        |
|            | CY54FCT399TLMB  | L61          | 20-Pin Square Leadless Chip Carrier |                 |

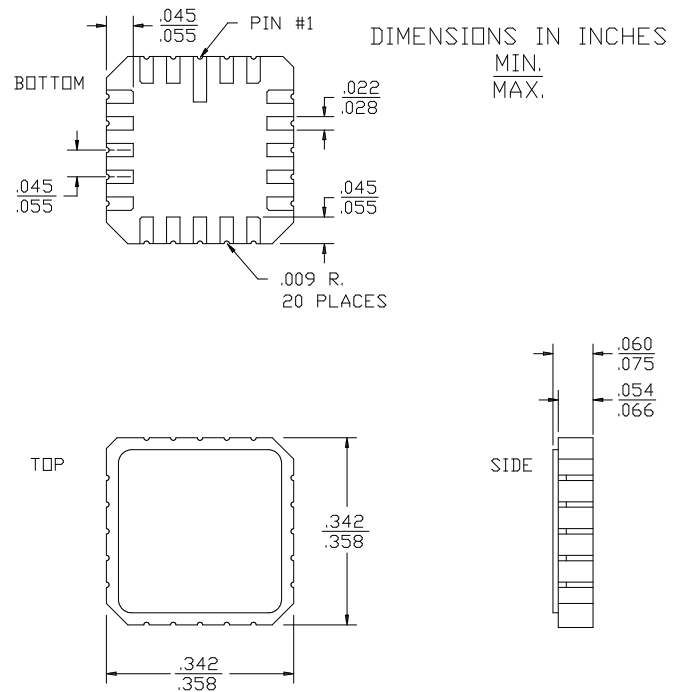
Document #: 38-00280-A

**Package Diagrams**

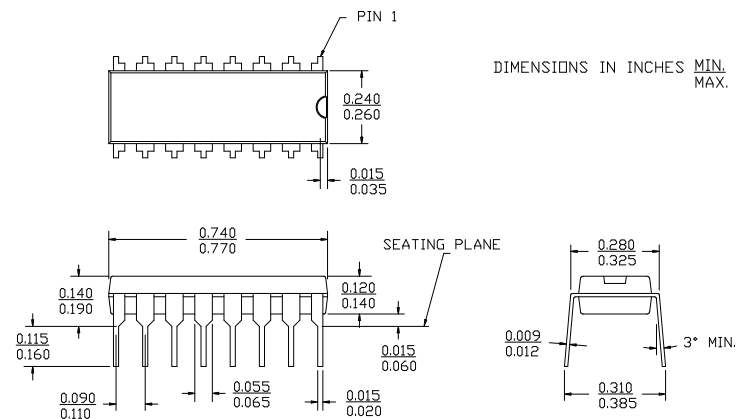
**16-Lead (300-Mil) CerDIP D2**  
MIL-STD-1835 D-2 Config. A



**20-Pin Square Leadless Chip Carrier L61**  
MIL-STD-1835 C-2A

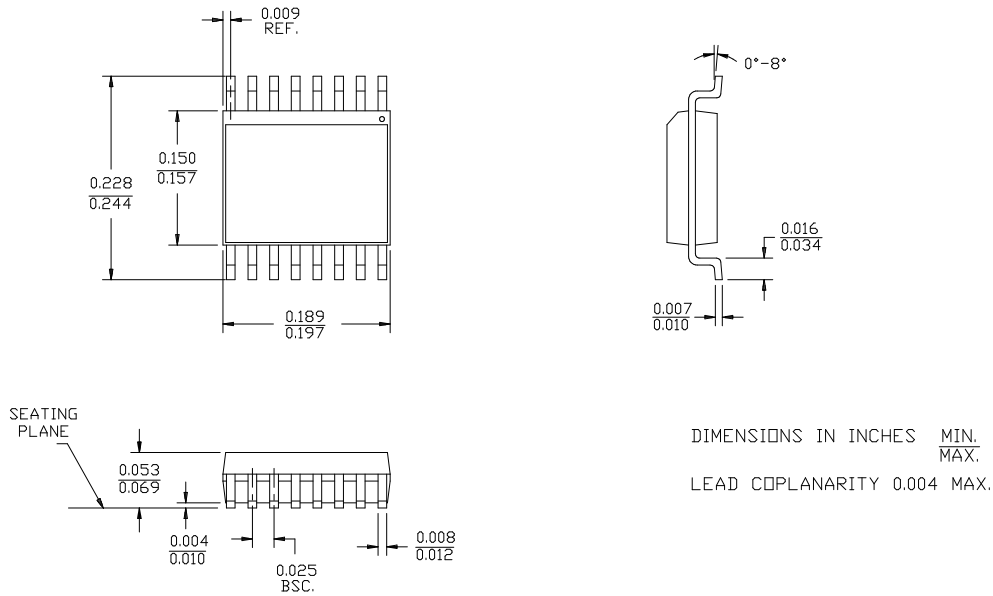


**16-Lead (300-Mil) Molded DIP P1**



Package Diagrams(continued)

16-Lead Quarter Size Outline Q1



16-Lead Molded SOIC S1

